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IMPLEMENTATION PLAN NAVY ENVIRONMENTAL LEADERSHIP PROGRAM TECHNOLOGY DEMONSTRATION FOR BIOREMEDIATION OF CONCRETE SURFACES AND SOIL AT SOLID WASTE MANAGEMENT UNIT 15 NS MAYPORT FL

11/1/1995

ABB ENVIRONMENTAL SERVICES

IMPLEMENTATION PLAN
NAVY ENVIRONMENTAL LEADERSHIP PROGRAM
TECHNOLOGY DEMONSTRATION FOR BIOAUGMENTATION AT SOLID WASTE MANAGEMENT UNIT 15

U.S. NAVAL STATION
MAYPORT, FLORIDA

Unit Identification Code: N60201

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November 1995

CERTIFICATION OF TECHNICAL
DATA CONFORMITY (MAY 1987)

The Contractor, ABB Environmental Services, Inc., hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. N62467-89-D-0317/028 are complete and accurate and comply with all requirements of this contract.

DATE: November 20, 1995

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(DFAR 252.227-7036)

FOREWORD

In order to meet its mission objectives, the U.S. Navy performs a variety of operations, some requiring the use, handling, storage, or disposal of hazardous materials. Through accidental spills and leaks and conventional methods of past disposal, hazardous materials may have entered the environment in ways unacceptable by today's standards. With growing knowledge of the long-term effects of hazardous materials on the environment, the Department of Defense initiated various programs to investigate and remediate conditions related to suspected past releases of hazardous materials at their facilities.

One of these programs is the Installation Restoration (IR) program. This program complies with the Comprehensive Environmental Response, Compensation, and Liability Act, as amended by the Superfund Amendments and Reauthorization Act. The acts, passed by Congress in 1980 and 1986, respectively, established the means to assess and clean up hazardous waste sites for both private-sector and Federal facilities. These acts are the basis for what is commonly known as the Superfund Program.

Originally, the Navy's part of this program was called the Navy Assessment and Control of Installation Pollutants (NACIP) program. Early reports reflect the NACIP process and terminology. The Navy eventually adapted the program structure and terminology of the standard IR program.

The IR program is conducted in several stages.

- The Preliminary Assessment (PA) identifies potential sites through record searches and interviews.
- A Site Inspection (SI) then confirms which areas contain contamination, constituting actual "sites." (Together, the PA and SI steps were called the Initial Assessment Study under the Navy's old NACIP program.)
- Next, the Remedial Investigation and Feasibility Study (RI/FS) together determine the type and extent of contamination, establish criteria for cleanup, and identify and evaluate any necessary remedial action alternatives and their costs. As part of the RI/FS,

a Risk Assessment identifies potential effects on human health or the environment in order to help evaluate remedial action alternatives.

- The selected alternative is planned and conducted in the Remedial Design and Remedial Action Stages. Monitoring then ensures the effectiveness of the effort.

A second program to address present hazardous material management is the Resource Conservation and Recovery Act (RCRA) Corrective Action Program. This program is designed to identify and cleanup releases of hazardous substances at RCRA-permitted facilities. RCRA is the law that ensures that solid and hazardous wastes are managed in an environmentally sound manner. The law applies primarily to facilities that generate or handle hazardous waste.

This program is conducted in three stages.

- The RCRA Facility Assessment identifies solid waste management units (SWMUs), evaluates the potential for releases of contaminants, and determines the need for future investigations.

- The RCRA Facility Investigation (RFI) then determines the nature, extent, and fate of contaminant releases.

- The Corrective Measures Study identifies and recommends measures to correct the release.

The hazardous waste investigations at Naval Station Mayport are presently being conducted under the RCRA Corrective Action Program. Earlier preliminary investigations had been conducted at Naval Station Mayport under the Navy's old NACIP program and IR program following Superfund guidelines. In 1988, in coordination with the U.S. Environmental Protection Agency (USEPA) and the Florida Department of Environmental Protection (FDEP), the hazardous waste investigations were formalized under the RCRA program.

Naval Station Mayport is conducting the cleanup at their facility by working through the Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM). The USEPA and the FDEP oversee the Navy environmental program. All aspects of the program are conducted in compliance with State and Federal regulations, as ensured by the participation of these regulatory agencies.

Questions regarding the RCRA Program at Naval Station Mayport should be addressed to Mr. David Driggers, Code 1852, at (803) 743-0501.

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GLOSSARY

ABB-ES	ABB Environmental Services, Inc.
bls	below land surface
	Liability Act
CMS	Corrective Measures Study
DDT	dichlorodiphenyltrichloroethane
FDEP	Florida Department of Environmental Protection
IR	Installation Restoration
NACIP	Naval Assessment for Control of Installation Pollutants
NAVSTA	Naval Station
NELP	Navy Environmental Leadership Program
PA	Preliminary Assessment
ppm	parts per million
RAP	Remedial Action Plan
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RGO	Remedial Goal Option
RI/FS	Remedial Investigation and Feasibility Study
SI	Site Inspection
SOUTHNAV-FACENGCOM	Southern Division, Naval Facilities Engineering Command
SWMU	Solid Waste Management Unit
USEPA	U.S. Environmental Protection Agency

1.0 INTRODUCTION

A technology demonstration is being conducted under the Navy Environmental Leadership Program (NELP) for *in situ* biological remediation of pesticide-contaminated soil at solid waste management unit (SWMU) 15 at Naval Station (NAVSTA) Mayport, Florida (Figure 1-1 and 1-2). NELP was created to promote the use of new and innovative technologies in the areas of compliance, conservation, cleanup, and pollution prevention within the Navy. NAVSTA Mayport was selected to participate in NELP because activities at this station are representative of similar activities at other naval stations.

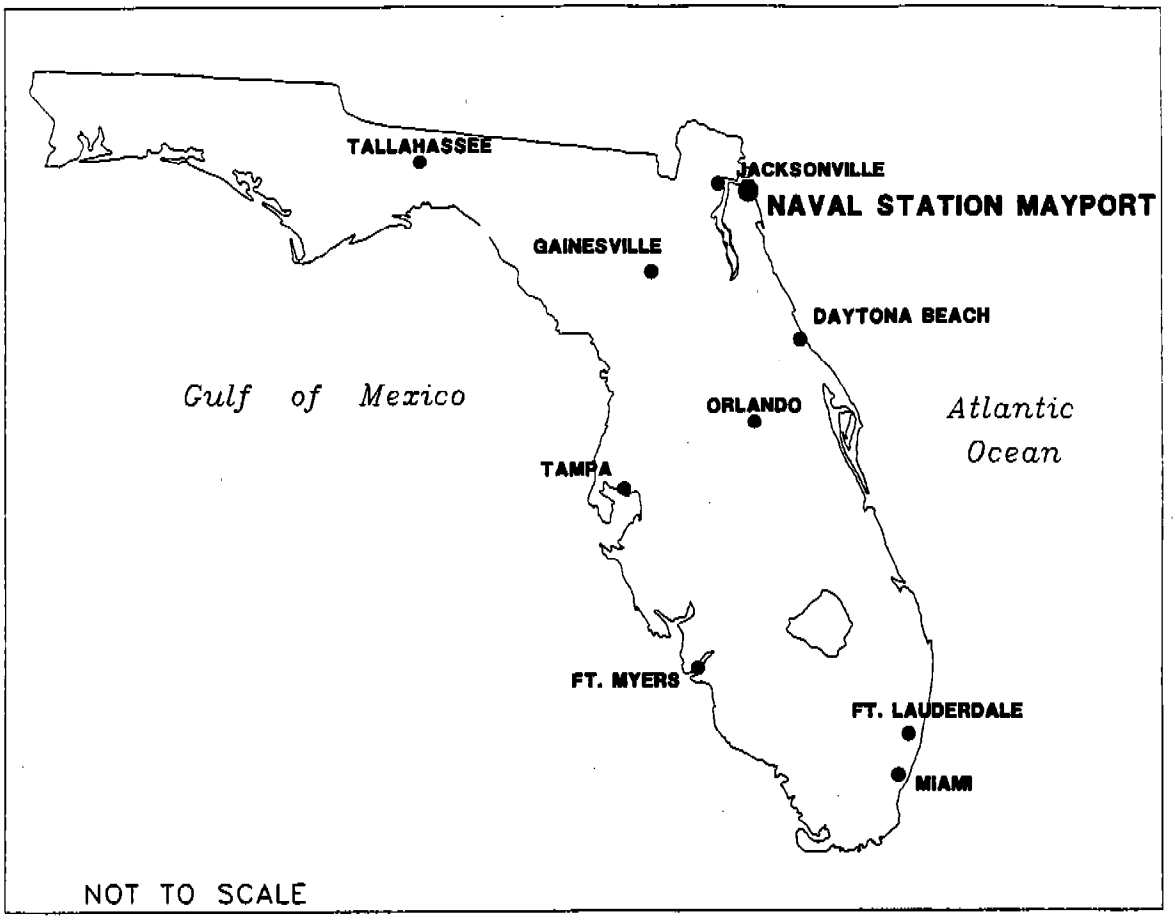
ABB Environmental Services, Inc. (ABB-ES), has been contracted by the Department of the Navy, Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM) to provide technical oversight for the technology demonstration by others at SWMU 15. This implementation plan was prepared to outline and describe activities and responsibilities necessary for technical oversight of the technology demonstration.

1.1 PURPOSE OF IMPLEMENTATION PLAN. This Implementation Plan includes the following activities:

- an overview of SWMU 15, including a summary of the site history, definition of contaminated areas, and identification of treatment levels;
- identification of the roles and responsibilities for implementation of the technology demonstration;
- a description of technical oversight activities to be performed by ABB-ES;
- an overview of the Technology Evaluation Report to be prepared by ABB-ES upon completion of the technology demonstration; and
- a schedule of activities for the technology demonstration.

1.2 REGULATORY HISTORY FOR SWMU 15. SWMU 15 is the Old Pesticide Handling Area and is located adjacent to Building 48-A (Figure 1-2) at NAVSTA Mayport. During the 1960s, pesticides and pesticide application equipment were stored in Building 48, formerly located adjacent to and east of Building 48-A. Mixing of pesticides and washing of pesticide application equipment may have occurred near the building. As a result, runoff from the washing and rinsing activities have infiltrated the ground surface.

In 1989, a Resource Conservation and Recovery Act (RCRA) Facility Assessment (A.T. Kearney, Inc., 1989) identified the Old Pesticide Handling Area as SWMU 15 and recommended the SWMU for an RCRA Facility Investigation (RFI). An RFI was completed for SWMU 15 in 1994 (ABB-ES, 1995a). Analysis of soil samples collected during the RFI for SWMU 15 suggest that soil from 0 to 1 foot below land surface (bls) was contaminated with pesticides, specifically 4,4'dichlorodiphenyltrichloroethane (DDT) and chlordane (Figure 1-3 and 1-4). Furthermore, human health and ecological risk assessments performed in conjunction with the RFI determined that these compounds may present adverse risk for the following exposures:



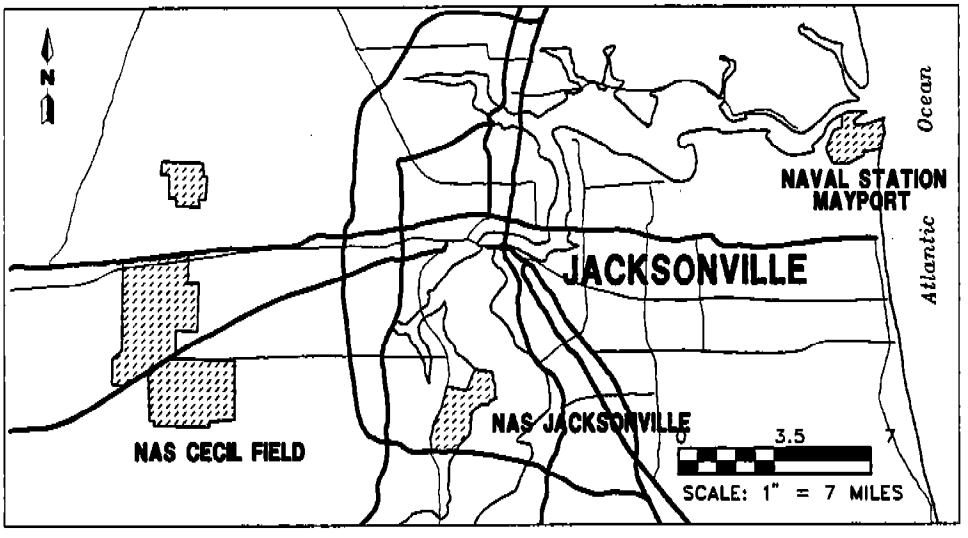


FIGURE 1-1
FACILITY LOCATION MAP

IMPLEMENTATION PLAN NELP TECHNOLOGY DEMONSTRATION

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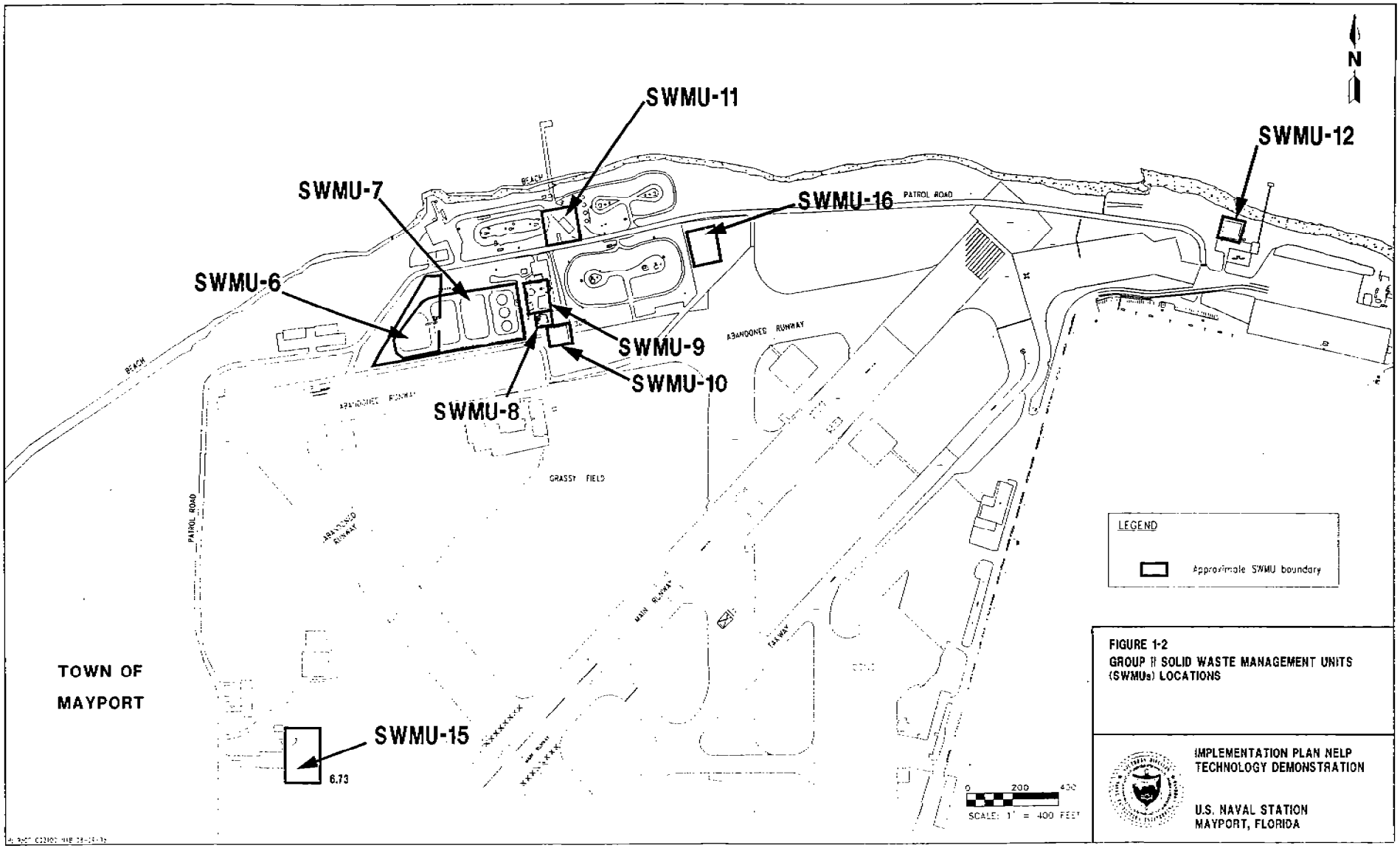

FIGURE 1-2
GROUP II SOLID WASTE MANAGEMENT UNITS
(SWMUs) LOCATIONS

IMPLEMENTATION PLAN NELP
TECHNOLOGY DEMONSTRATION

U.S. NAVAL STATION
MAYPORT, FLORIDA

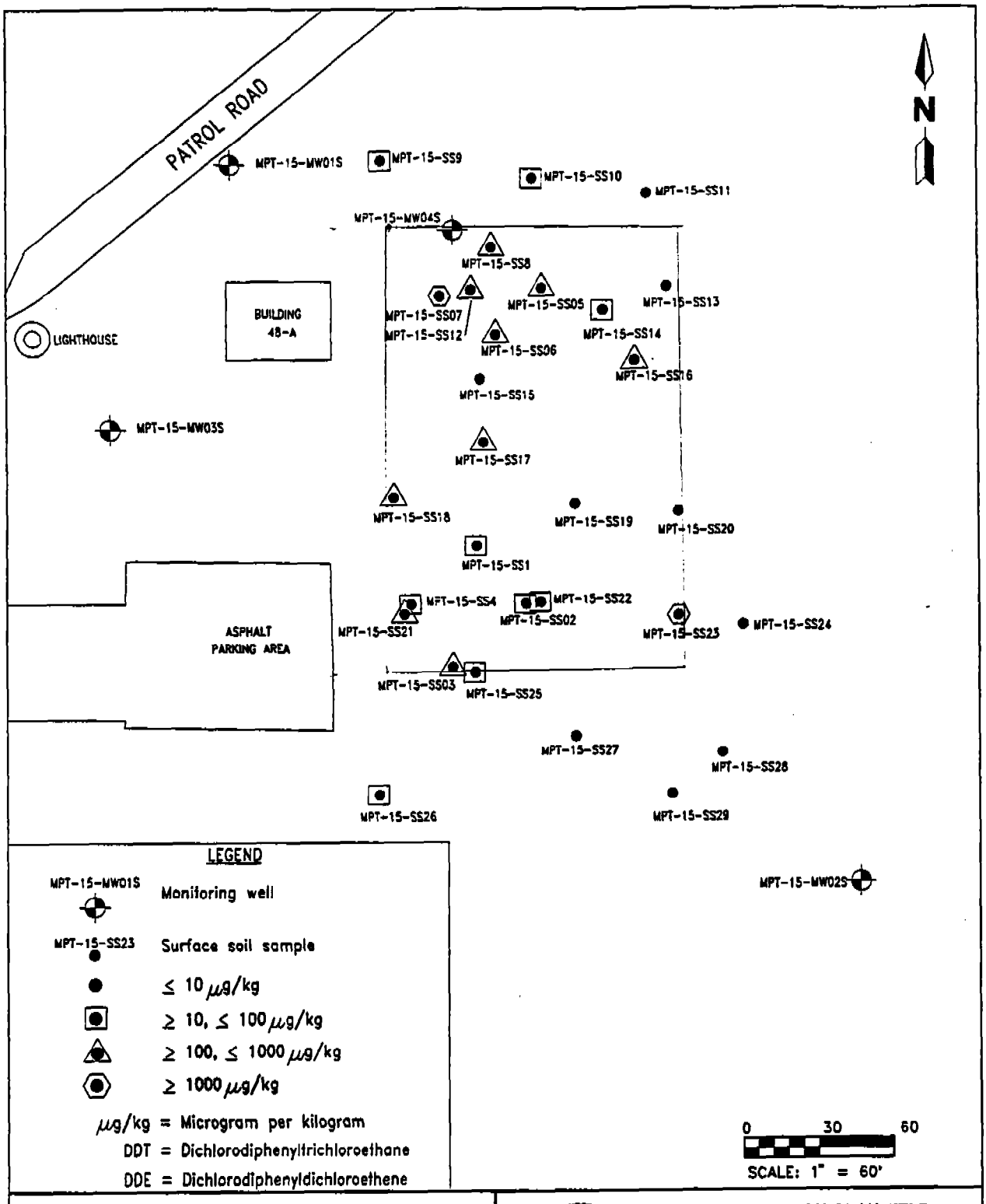

FIGURE 1-3

TOTAL 4,4-DDT AND 4,4-DDE CONCENTRATIONS DETECTED IN SURFACE SOIL SAMPLES AT SWMU 15

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IMPLEMENTATION PLAN NELP TECHNOLOGY DEMONSTRATION

U.S. NAVAL STATION MAYPORT, FLORIDA

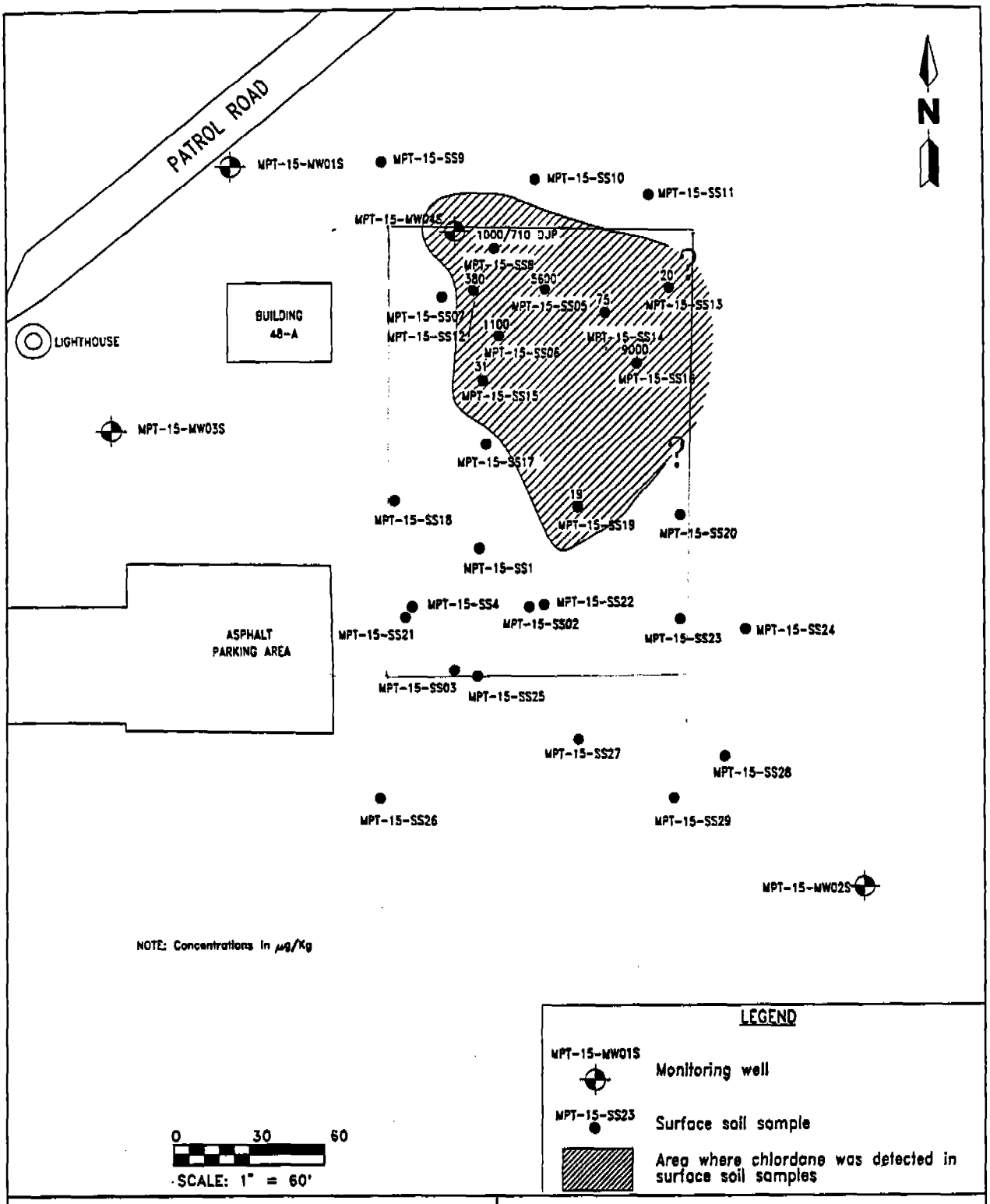

FIGURE 1-4

CHLORDANE CONCENTRATIONS DETECTED IN SURFACE SOIL SAMPLES AT SWMU 15

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- there is a potential risk to human receptors from dermal exposure to 4,4'-DDT and chlordane in surface soil,
- there is a potential risk to a maintenance worker from exposure to 4,4'-DDT in subsurface soil, and
- there is a potential risk to ecological receptors from exposure to 4,4'-DDT in surface soil.

Based on the analytical results of the soil samples and potential human health and ecological risk, SWMU 15 was recommended for a Corrective Measures Study (CMS) (ABB-ES, 1995b). The CMS for SWMU 15 identified one Corrective Action Objective for SWMU 15 soil: "Eliminate the potential for human and ecological receptors to contact pesticide-contaminated soil at SWMU 15." The development of corrective action alternatives for the CMS considered the NELP technology demonstration being undertaken at SWMU 15 and alternative cleanup options for the pesticide-contaminated soil in case the technology demonstration does not meet the remedial goal options (RGOs) established for the site.

1.3 TREATMENT LEVELS FOR CONTAMINATED SOIL AT SWMU 15. Target treatment levels for cleanup of soil containing the pesticides 4,4'-DDT and/or chlordane are based on the RGOs selected to be protective of ecological and human receptors (Table 1-1). The treatment level (1 microgram per kilogram [µg/kg]) for 4,4'-DDT is based on the ingestion of 4,4'-DDT by an avian species such as a robin (ABB-ES, 1995a). The treatment level for chlordane (2,100 µg/kg) is the Florida Department of Environmental Protection (FDEP) soil cleanup goal based on leachability. The leachability soil cleanup goal was selected because of the detection of the pesticides alpha- and beta-benzene hexachloride (BHC) in groundwater samples. Alpha- and Beta-BHC may be a minor or trace component in chlordane. It should be noted that chlordane was not detected in the groundwater samples collected from SWMU 15.

1.4 VOLUME OF CONTAMINATED SOIL AT SWMU 15. The volume of pesticide-contaminated soil was estimated during the CMS. Appendix A of this plan provides detailed information on these calculations. The volume of contaminated soil at SWMU 15 was calculated using the following assumptions.

- The lateral extent of contaminated soil (i.e., surface soil) was estimated based on concentrations of chlordane and 4,4'-DDT in surface soil samples.
- The vertical extent of chlordane-contaminated soil was assumed to be 1 foot bls, based on concentrations of chlordane found in subsurface soil samples (greater than 1 foot bls).
- The vertical extent of 4,4'-DDT-contaminated soil was assumed to be 1 foot bls, based on concentrations of 4,4'-DDT in subsurface soil samples, except in areas where detection in surface soil exceeded the treatment levels shown in Table 1-1. In these areas the concentrations of 4,4'-DDT in subsurface soil samples were estimated with a fate and transport model. The model predicted that, in some areas, 4,4'-DDT may have migrated to 2 or 3 feet bls.

Based on these assumptions, the total volume of contaminated soil at SWMU 15 is estimated to be approximately 533 cubic yards.

Table 1-1
Target Treatment Levels for SWMU 15 Soil

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Chemical	Target Treatment Level (µg/kg)
4,4'-DDT	1,000
Chlordane	2,100[2]

[1] Value is based on the ingestion of 4,4'-DDT by an avian species such as a robin (ABB-ES, 1995).
[2] Value is based on Florida Department of Environmental Protection (FDEP) soil cleanup goal (leachability) from Florida Department of Environmental Protection, Soil Cleanup Goals for the Military Sites (April 5, 1995).

Notes: SWMU = Solid Waste Management Unit.
DDT = dichlorodiphenyltrichloroethane.
µg/kg = micrograms per kilogram.

2.0 PROPOSED NELP ACTIVITIES FOR SWMU 15

Through NELP, the Navy proposes to demonstrate bioremediation of pesticide-contaminated soils at SWMU 15. FIFCO International has been selected as the contractor for the Navy and intends to implement an *in situ* bioremediation process for degradation of 4,4'-DDT and chlordane detected in soil samples from the SWMU.

FIFCO will apply a proprietary microorganism mixture, in liquid form, to soil at SWMU 15. The mixture contains microorganisms capable of degrading a variety of organic contaminants. In addition, other nutrients and amendments will be added to the soil to further accelerate biodegradation. The microorganisms and the nutrients and amendments will be mixed in separate tanks before being applied to SWMU 15.

According to FIFCO's *Revised Remedial Action Plan* (RAP) (FIFCO, 1995), the technology demonstration will be conducted over 60 days. This is the amount of time FIFCO estimates is required for degradation of 4,4'-DDT and chlordane to concentrations below treatment levels. During the technology demonstration, FIFCO will collect soil samples to monitor and assess the performance of the microorganisms as described in the RAP.

3.0 IMPLEMENTATION OF NELP TECHNOLOGY FOR SWMU 15

This chapter includes an overview of the activities necessary for implementation of the technology, the oversight activities to be conducted by ABB-ES, the confirmatory sampling and analysis program, and how analytical results will be evaluated upon completion of the technology demonstration.

3.1 OVERVIEW OF ACTIVITIES FOR IMPLEMENTATION. As a part of implementing the NELP technology demonstration, the following activities are planned.

- FIFCO submits a final Remedial Action Plan for the technology demonstration.
- ABB-ES submits a final Implementation Plan for the technology demonstration.
- FIFCO Remedial Action Plan and ABB-ES Implementation Plan are approved by NAVSTA Mayport, SOUTHNAVFACENGCOM, the FDEP, and the U.S. Environmental Protection Agency (USEPA).
- Soil samples are to be collected by ABB-ES at SWMU 15 to provide a baseline to assess the performance of the bioremediation relative to the target treatment levels (Table 1-1).
- Technology demonstration occurs (as described in the FIFCO RAP).
- Soil samples are collected and analyzed to assess whether the technology has achieved the target treatment levels.
- A Technology Evaluation Report is prepared by ABB-ES describing the implementation and results of the technology demonstration.

A Responsibility Assignment Matrix outlines the activities necessary for the technology demonstration and identifies the parties who have lead, support, review, or approval responsibility (Table 3-1).

3.2 TECHNICAL OVERSIGHT OF TECHNOLOGY DEMONSTRATION. ABB-ES will provide technical oversight of the technology demonstration contractor, FIFCO. ABB-ES will be onsite during the technology demonstration to observe contractor's activities, including:

- site preparation,
- construction,
- operation and maintenance activities, and
- the administration of any ancillary equipment or services to evaluate the technology (e.g., air monitoring devices or laboratory analytical services).

Table 3-1
Responsibility Assignment Matrix

Implementation Plan, Navy Environmental Leadership Program
Technology Demonstration for Bioaugmentation at Solid Waste Management Unit 15
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Task	ABB-ES	FIFCO	SOUTHNAV-FACENGCOM	ACTIVITY	FDEP	USEPA
Provide Technology Demonstration Workplan (RAP)	Review	Lead	Approval	Approval	Approval	Approval
Provide Implementation Plan	Lead	Information	Approval	Approval	Approval	Approval
Perform Baseline and Hot Spot Sampling	Lead	Information	Support	Review	–	–
Implement Technology Demonstration	Support	Lead	Support	Support	–	–
Implement Confirmatory Sampling/Performance Verification	Lead	Support	Support	Support	–	–
Technology Evaluation Report	Lead	Information	Approval	Review	Approval	Approval

Notes: ABB-ES = ABB Environmental Services, Inc.
FIFCO = FIFCO International, Inc.
SOUTHNAVFACENGCOM = Southern Division, Naval Facilities Engineering Command.
ACTIVITY = Naval Station Mayport.
FDEP = Florida Department of Environmental Protection.
USEPA = U.S. Environmental Protection Agency.
RAP = Remedial Action Plan.

ABB-ES will also collect soil samples as outlined in Section 3.3. Oversight activities and soil sample analytical results will be described in a Technology Evaluation Report (see Section 3.4).

3.3 SAMPLING AND ANALYSIS PROGRAM. The methodology for surface soil sample collection will be consistent with standard operating procedures described in the NAVSTA Mayport RFI Workplan (ABB-ES, 1991), the NAVSTA Mayport General Information Report (ABB-ES, 1995c), and USEPA Region IV standard operating procedures (USEPA, 1991). The soil samples will be shipped to the laboratory by express-overnight delivery under the chain-of-custody protocol.

As a part of the technology demonstration for SWMU 15, soil samples will be collected and analyzed by ABB-ES. The analytical results will be evaluated to assess whether the technology demonstration, performed by FIFCO, has achieved the target treatment levels. FIFCO will also be collecting soil samples before, during, and after the NELP technology demonstration independent of the sampling to be conducted by ABB-ES.

The following provides the rationale for collection and analysis of soil samples at SWMU 15 during the technology demonstration.

3.3.1 Assessment of Potential Hot Spots Figures 1-3 and 1-4 show soil sampling locations where the pesticides were detected. The RFI identified the lateral and vertical extent of pesticide-contaminated soils at SWMU 15. However, limited areas require additional sampling to assess the potential that hot spots may exist outside the area studied as stated in the RFI report (ABB-ES, 1995a). This sampling is required to ensure that the remedial effort encompasses areas that may represent potential threats to human or ecological receptors.

Based on the locations of samples collected during the RFI, three areas (Figure 3-1) require additional characterization to assess the potential for hot spots prior to the NELP technology demonstration. Because surface soil samples have not been collected in these areas, the presence or absence of pesticides in soil has not been determined.

Three surface soil samples (MPT-15-SS31, MPT-15-SS32, and MPT-15-SS33) are proposed to assess the presence of 4,4'-DDT in surface soil (Table 3-2). 4,4'-DDT was detected at a concentration of 790 parts per million (ppm) in the southeastern part of the SWMU (MPT-15-SS23) and at a concentration of 1.5 ppm in the northwestern part of the SWMU (MPT-15-SS07). Surface soil samples are proposed to be collected northwest and south of MPT-15-SS23 and west of MPT-15-SS07. Two surface soil samples, MPT-15-SS32 and MPT-15-SS33, will be collected near MPT-15-SS23; one surface soil sample, MPT-15-SS31, is proposed to be placed west of MPT-15-SS07. The surface soil samples will be collected from 0 to 1 foot bls.

The sampling and analysis program will consist of two parts; one is the assessment of hot spots identified during the previous sampling events for the RFI, and the other is the collection of baseline and performance samples that will be used in conjunction with the existing samples to assess the effectiveness of the technology demonstration.

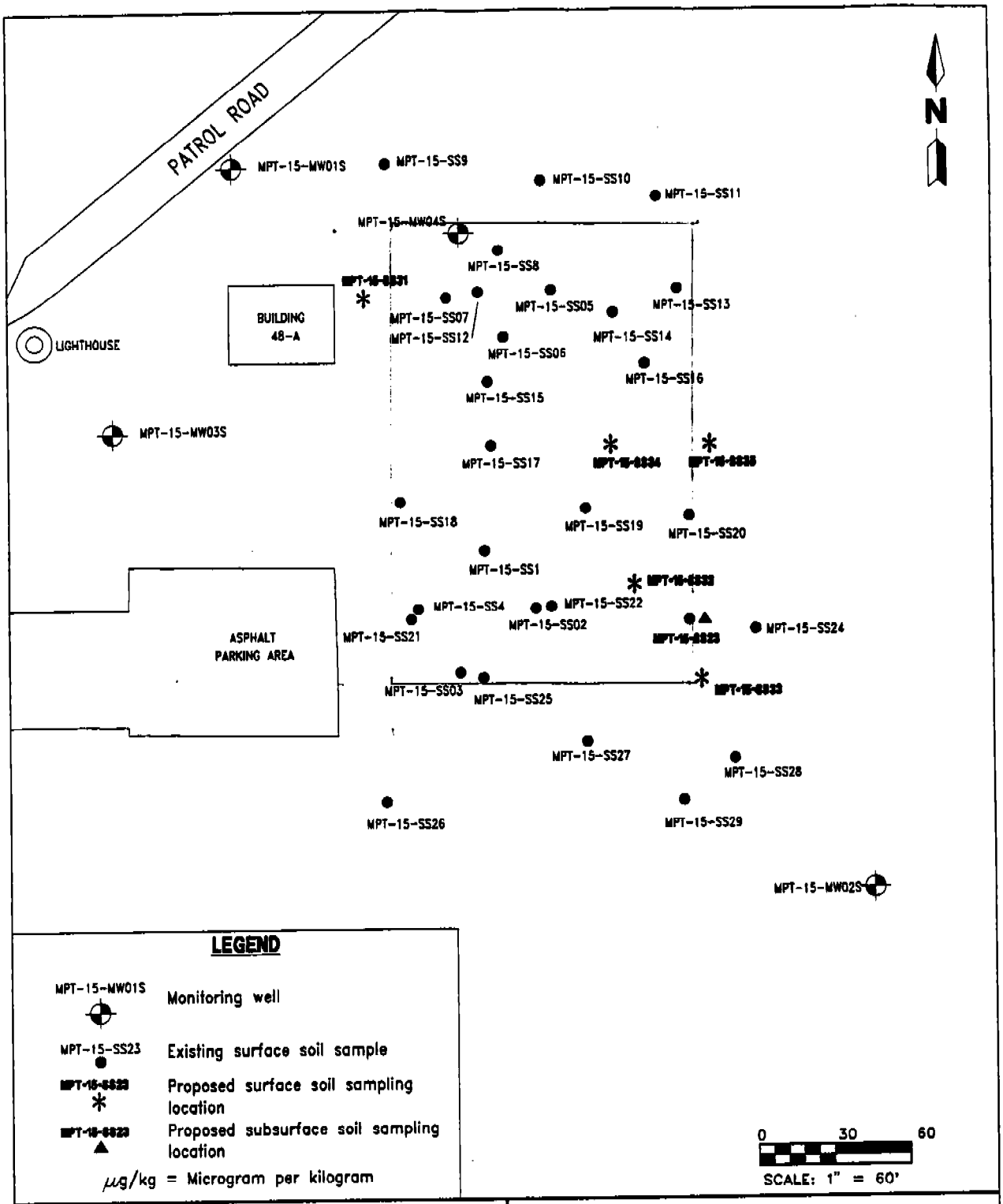

FIGURE 3-1
ASSESSMENT OF POTENTIAL HOT SPOTS AT SWMU 15

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Table 3-2
Summary of Sampling and Analysis Program

Implementation Plan, Navy Environmental Leadership Program
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Sample Number	Sample Depth (ft/bls)	Purpose	Analytical Method
MPT-15-SS31	0 to 1	Hot Spot Assessment	USEPA 8080
MPT-15-SS32	0 to 1	Hot Spot Assessment	USEPA 8080
MPT-15-SS33	0 to 1	Hot Spot Assessment	USEPA 8080
MPT-15-SS34	0 to 1	Hot Spot Assessment	USEPA 8080
MPT-15-SS35	0 to 1	Hot Spot Assessment	USEPA 8080
MPT-15-BS23	1 to 2	Hot Spot Assessment	USEPA 8080
MPT-15-SS16	0 to 1	Baseline	USEPA 8080
MPT-15-SS23	0 to 1	Baseline	USEPA 8080
MPT-15-SS05	0 to 1	Performance	USEPA 8080
MPT-15-SS07	0 to 1	Performance	USEPA 8080
MPT-15-SS16	0 to 1	Performance	USEPA 8080
MPT-15-SS23	0 to 1	Performance	USEPA 8080
MPT-15-SB05	1 to 2	Performance	USEPA 8080
MPT-15-SB07	1 to 2	Performance	USEPA 8080
MPT-15-SB16	1 to 2	Performance	USEPA 8080
MPT-15-SB23	1 to 2	Performance	USEPA 8080
MPT-15-SS36 Through MPT-15-SS45	0 to 1	Performance	USEPA 8080
MPT-15-SS04	1 to 2	Performance	USEPA 8080
Duplicate (3 samples)	TBA	QC	USEPA 8080
Rinsate (2 samples)	NA	QC	USEPA 8080
MS/MSD (2 sample pairs)	TBA	QC	USEPA8080

Sample number for Duplicates, Rinsates, and MS/MSD sample pairs are to be determined at time of sample collection.

Notes: ft/bls = feet beneath the land surface.
MPT = U.S. Naval Station, Mayport, Florida.
SS = Surface soil sample.
USEPA = U.S. Environmental Protection Agency.
SB = Subsurface soil sample.
TBA = To be selected at time of sampling.
NA = Sample depth not applicable, equipment rinsate sample using organic free water.
QC = quality control sample.
MS/MSD = matrix spike/matrix spike duplicate samples.

Two surface soil samples (MPT-15-SS34 and MPT-15-SS35) are proposed to assess the presence of hot spots of chlordane (Figure 3-1 and Table 3-2). Chlordane was detected at a concentration of 5.7 ppm at sampling location MPT-15-SS05 and at a concentration of 9.0 ppm at sampling location MPT-15-SS16. Surface soil samples, MPT-15-SS34 and MPT-15-SS35, are proposed to be collected in the area south of sampling location MPT-15-SS16.

One subsurface soil sample (MPT-15-SB23) is proposed at the location of existing surface soil sample MPT-15-SS23 (Figure 3-1 and Table 3-2). The detection of 4,4'-DDT at a concentration of 790 ppm in the surface soil sample at this location suggests that 4,4'-DDT may have migrated vertically; however, a subsurface soil sample was not collected at MPT-15-SS23. The subsurface soil sample will be collected from 1 to 2 feet bls to assess whether the pesticides have migrated vertically.

3.3.2 Technology Evaluation Sampling Baseline and performance soil samples will be collected prior to and upon completion, respectively, of the technology demonstration to assess whether the *in situ* bioremediation has achieved treatment levels. Two surface soil samples will be collected before implementation of the technology demonstration, and 16 surface soil and 4 subsurface samples will be collected upon completion to assess the technology's performance (Figure 3-2).

Baseline conditions should be determined in order to evaluate the effectiveness of the NELP demonstration. Baseline conditions will be based on previous analytical results and by collecting the hot spot assessment and two additional surface soil samples prior to the implementation of the technology demonstration (Figure 3-2 and Table 3-2). One surface soil sample at MPT-15-SS16 is proposed to determine the current baseline concentration for chlordane, and one surface soil sample at MPT-15-SS23 is proposed to determine the current baseline concentration for 4,4'-DDT (Figure 3-2). Each surface soil sample will be collected 0 to 1 foot bls; during sampling the locations will be marked with a visible object that will not disrupt the demonstration. Analytical results of these and existing samples will be compared to performance samples collected at the end of the NELP demonstration.

Performance sample locations were identified to bias sample collection toward known contaminated areas, to randomly select soil samples surrounding these contaminated areas, and to assess the effects of the technology demonstration on low levels (less than 1 ppm) of pesticides in soil (Figure 3-2 and Table 3-2).

Four biased performance sample locations are proposed. The biased samples are at two existing sampling locations where 4,4'-DDT and chlordane were detected above treatment levels (MPT-15-SS05, MPT-15-SS07, MPT-15-SS16, and MPT-15-SS23). Surface and subsurface soil samples will be collected from intervals 0 to 1 foot bls and 1 to 2 feet bls, respectively.

Soil samples will also be collected at random locations around each of these areas. The selection of random sampling locations was based on geostatistical evaluation at a 90 percent confidence level that a hot spot would not be missed (Appendix B). Random samples (MPT-15-SS36 through MPT-15-SS45) were placed only within areas where 4,4'DDT and chlordane exceed the target treatment levels (Figure 3-2 and Table 3-2). Surface soil samples will be collected 0 to 1 foot bls at these locations.

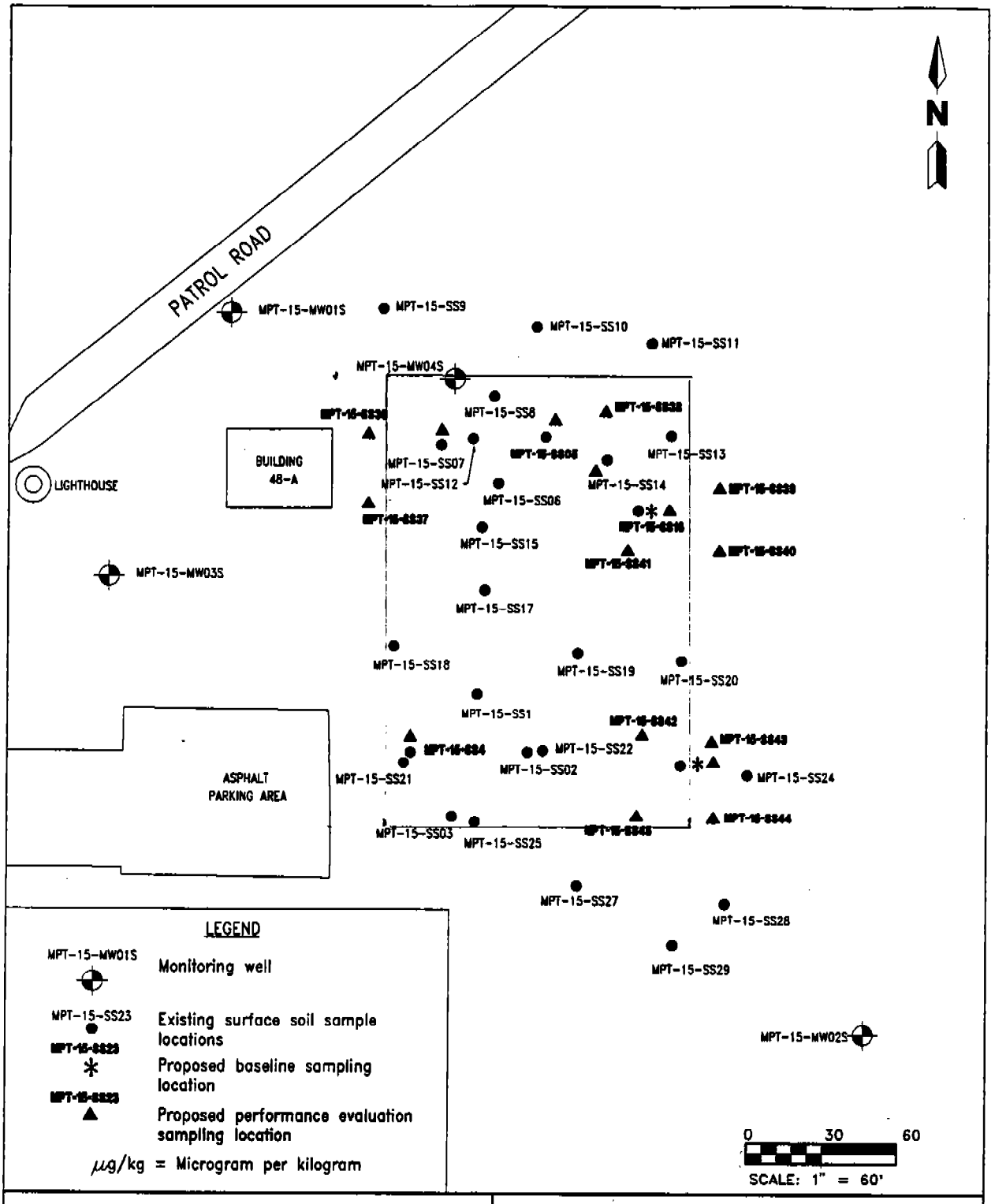

FIGURE 3-2
BASELINE AND PERFORMANCE EVALUATION SAMPLING LOCATIONS

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One soil sample will be collected at MPT-15-SS4, where FIFCO is also collecting a sample. Analysis of this sample will serve two purposes: 1) to evaluate the effects of the technology demonstration on low levels of pesticides in soil and 2) assess the accuracy of FIFCO's analysis.

In addition to the soil samples collected prior to and during the technology demonstration, measurements of rain fall and maximum and minimum air temperatures will be obtained from the NAVSTA Mayport meteorology department. The period that the measurements will be obtained include 1 month prior to the date the technology demonstration begins up to the date the performance evaluation samples are collected.

3.3.3 **Analytical Program** The analysis of the soil samples will be conducted using USEPA method 8080 by the methodology contained in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, USEPA SW846 (USEPA, 1986). The analytical data package produced by the laboratory will be Naval Energy and Environment Support Activity (NEESA) Level C. The rationale for using NEESA Level C is to provide analytical data that could be validated substituting the SW846 method criteria for USEPA's Contract Laboratory Program (CLP) method criteria using National Functional Guidelines for Organic Data Review (USEPA, 1990). The data will be validated so that the appropriate decision can be made as to whether soil at the site should be further evaluated by the Corrective Measures Study under NAVSTA Mayport RCRA Corrective Action Program.

Because 4,4'-DDT and chlordane are the contaminants of potential concern at SWMU 15, soil samples will be analyzed using SW-846 method 8080 for chlorinated pesticides.

3.3.4 **Interpretation of Analytical Results** Analytical results from the confirmatory soil sampling program will be evaluated by direct comparison to the target treatment levels in Table 1-1. FIFCO has indicated in their revised Remedial Action Plan that bioaugmentation should achieve the target treatment levels. If analytical results from the confirmatory sampling program indicate the presence of 4,4'-DDT or chlordane in soil in excess of target treatment levels (Table 1-1), the technology demonstration will not be considered effective in meeting the goal of the Corrective Measure Study.

However, analytical results of the confirmatory sampling program also will be compared to *Soil Cleanup Goals for the Military Sites* (FDEP, 1995). The ability of the technology demonstration to successfully meet these alternate target cleanup goals will be discussed in the Technology Evaluation Report.

3.4 **TECHNOLOGY EVALUATION REPORT**. A Technology Evaluation Report will be prepared for the Navy by ABB-ES to export information on the innovative technology within SOUTHNAVFACENGCOM and the Navy. The report will include descriptions of the technology demonstration and oversight activities performed by ABB-ES, photographs of the technology demonstration, a discussion of the results of the sampling and analysis activities, and an evaluation of the effectiveness of the technology at achieving target treatment levels (Table 3-3).

The effectiveness of the technology demonstration will be evaluated by comparing analytical results of soil samples collected during confirmatory sampling to target treatment levels (Tables 1-1 and 3-3). The percent reduction of 4,4'-DDT

Table 3-3
Alternate Target Cleanup Goals

Implementation Plan, Navy Environmental Leadership Program
Technology Demonstration for Bioaugmentation at Solid Waste Management Unit 15
U.S. Naval Station
Mayport, Florida

Chemical	Human Health Treatment Level (Industrial)[1]	Human Health Treatment Level (Residential)[2]	Human Health Treatment Level (Leachability)[3]	Ecological Treatment Level[4]
4,4-DDT	12,000	3,100	500	1,000
Chlordane	2,800	800	2,100	--

[1] Soil Cleanup Goals for Military Sites in Florida, April 5, 1995, Industrial Exposure.
[2] Soil Cleanup Goals for Military Sites in Florida, April 5, 1995, Residential Exposure.
[3] Soil Cleanup Goals for Military Sites in Florida, April 5, 1995, Leaching Value.
[4] Based on ingestion of reference toxicity value for robin (ABB-ES, 1995a).

Notes: SWMU = solid waste management unit.
DDT = dichlorodiphenyltrichloroethane.
All values expressed as micrograms per kilogram.

and chlordane concentrations will be calculated and will be based on comparison to the data collected in the RFI and the baseline samples. The report also will evaluate the presence and concentrations of the degradation by-products of 4,4'-DDT and chlordane.

The uncertainty associated with measuring the technology demonstration's ability to meet the target cleanup goals (Tables 1-1 and 3-3) will also be discussed.

The findings from the technology demonstration will be summarized in a conclusions section.

Correspondence separate from the technology evaluation report will identify whether additional corrective action activities are necessary. An outline of the technology evaluation report is provided in Table 3-4.

Table 3-4
Outline of Technology Evaluation Report

Implementation Plan, Navy Environmental Leadership Program
Technology Demonstration for Bioaugmentation at Solid Waste Management Unit 15
U.S. Naval Station
Mayport, Florida

1.0 INTRODUCTION

2.0 SUMMARY OF TECHNOLOGY DEMONSTRATION

- 2.1 ACTIVITIES
- 2.2 FIELD DEMONSTRATION
- 2.3 MONITORING ACTIVITIES DURING DEMONSTRATION
- 2.4 PHOTOGRAPHS

3.0 SUMMARY OF OVERSIGHT ACTIVITIES

- 3.1 GENERAL OBSERVATIONS AND NOTES
- 3.2 ANALYTICAL RESULTS FROM HOT SPOT SAMPLING
- 3.3 ANALYTICAL RESULTS FROM TECHNOLOGY EVALUATION SAMPLING

4.0 EVALUATION OF TECHNOLOGY DEMONSTRATION

- 4.1 TECHNOLOGY DEMONSTRATION COMPARED TO TREATMENT LEVELS

5.0 UNCERTAINTY ANALYSIS

6.0 CONCLUSIONS

REFERENCES

ABB Environmental Services, Inc. (ABB-ES), 1991, Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Workplan, U.S. Naval Station, Mayport, Florida, Volumes I, II, and II (Interim Final): prepared for Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), North Charleston, South Carolina, October.

ABB-ES, 1995a, Resource Conservation and Recovery Act (RCRA) Facility Investigation Group II Solid Waste Management Units (SWMUs), U.S. Naval Station Mayport, Florida: prepared for Southern Division Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), North Charleston, South Carolina.

ABB-ES, 1995b, Corrective Measures Study Group II Solid Waste Management Units (SWMUs), U.S. Naval Station Mayport, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina.

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ABB-ES, 1994, RCRA Facility Investigation Group II Solid Waste Management Units (SWMUs), U.S. Naval Station Mayport, Florida: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina.

A.T. Kearney, Inc., 1989, RCRA Facility Assessment of the Naval Station Mayport, Jacksonville, Florida, Prepared for the U.S. Environmental Protection Agency, Atlanta, Georgia, September.

FIFCO International (FIFCO), 1995, Revised Remedial Action Plan (RAP), Naval Station, Mayport, Florida, Category #1, Area #1, Pesticide Area, SWMU 15: prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina, August.

Florida Department of Environmental Protection (FDEP), 1995, Soil Cleanup Goals for the Military Sites, Personal Correspondence from Ligia Mora-Applegate (FDEP) to Tim Bahr (FDEP), April 5.

U.S. Environmental Protection Agency (USEPA), 1985, Test Methods for Evaluating Solid Waste, Physical and Chemical Methods: SW846.

USEPA, 1991, Environmental Compliance Branch Standard Operation Procedures and Quality Assurance Manual, USEPA Region IV, Environmental Services Branch, Athens, Georgia, February.

USEPA, 1990, National Functional Guidelines for Organic Data Review: December (revised June, 1991).

APPENDIX A

VOLUME OF CONTAMINATED SOIL AT SWMU 15

VOLUME OF CONTAMINATED SOIL - SWMU 15 - ESTIMATE RATIONALE

The volume of pesticide-contaminated soil was calculated by including areas where analytical data indicated detections of 4,4'-DDT and chlordane in surface soil above MPSs.

Volume of Soil Containing 4,4'-DDT 4,4'-DDT was detected in surface soil at a concentration of 790 ppm in the southeastern portion of the SWMU (MPT-15-SS23), and at a concentration of 1.5 ppm in the northwestern portion of the SWMU (MPT-15-SS07). Only one surface soil sample was collected adjacent to MPT-15-SS23, and only one surface soil sample was collected adjacent to MPT-15-SS07. As a result, there are areas surrounding these samples where the concentrations of 4,4'-DDT in soil are unknown. Therefore, the areal extent of concentrations of 4,4'-DDT in excess of 1 ppm was estimated based on detections and non-detections of the chemical in outlying surface soil samples. The attached figure shows these estimated areas.

Additionally, no subsurface soil samples were collected at MPT-15-SS23. The detection of 790 ppm of 4,4'-DDT in the surface soil sample collected at this location suggests that 4,4'-DDT would most likely be found at some lower concentration in subsurface soil. As a result, a fate and transport model described by Jury, et. al. (1990), was performed to estimate the concentration of 4,4'-DDT in subsurface soil. The model assumed that the initial pesticide spill (containing 4,4'-DDT) penetrated the soil to 2 feet bls. The model results indicated that 4,4'-DDT would not have migrated in subsurface soil below 3 feet. Model assumptions, data, and results are attached.

Based on the modelling results, a 15 by 20 by 3 foot area surrounding surface soil sample MPT-15-SS23 was assumed to have 4,4'-DDT exceeding the MPS, and a 30 by 40 by 2 foot area surrounding the area described above is assumed to have concentrations of 4,4'-DDT in excess of the MPS (see attached figure).

The total volume of soil contaminated with 4,4'-DDT for the purposes of the CMS is approximately 321 yd^3. The attached calculation sheets show in more detail how the volume of soil contaminated with 4,4'-DDT was estimated.

Volume of Soil Containing Chlordane Chlordane was detected in two surface soil samples at SWMU 15 at concentrations of 9 and 5.6 ppm (in surface soil samples MPT-15-SS16 and MPT-15-SS05, respectively). These samples were located in the northeast area of the SWMU. Additional surface soil samples were not collected in the immediate vicinity of these locations. As a result, the areal extent of surface soil containing chlordane in excess of the MPS was estimated based on detections and nondetections of chlordane in outlying surface soil samples. The attached figure shows the areal extent of chlordane contamination.

One subsurface soil sample was collected from location MPT-15-SS05, and chlordane was detected at a concentration of 0.18 ppm. This concentration is well below the MPS

for chlordane. Since no subsurface soil sample was collected from MPT-15-SS16, the concentration of chlordane in subsurface soil was estimated. This was accomplished by backcalculating the conditions at MPT-15-SS05; which indicate that a 97% reduction in chlordane concentration could be expected in subsurface soil at MPT-15-SS16. As a result, the chlordane concentration in subsurface soil at MPT-15-SS16 would be approximately 0.28 ppm, which is below the MPS. An attached sheet shows this calculation.

As a result, the total volume of soil contaminated with chlordane for the purposes of the CMS is approximately 211 yd^3. The attached calculation sheets show in more detail how the volume of soil contaminated with chlordane was calculated.

Total Volume of Soil Containing 4,4'-DDT and Chlordane The total volume of soil at SWMU 15 containing either 4,4'-DDT or chlordane in excess of media protection standards is: 533 yd^3 or 14,400 ft^3.

PROJECT	COMP. BY	JOB NO.
NAVAL STATION Mayport Group II SWMUS - SWMU 15 Volumes of Contam. Media	TJH	08533.29
	CHK. BY: LDP	DATE: 6.5.95

Assumptions

1) Evaluating three different areas: the two areas containing 4,4'-DDT concentrations exceeding 1 ppm and the one area containing chlordane concentrations exceeding 2.75 ppm.

2) For area surrounding 790 ppm 4,4'-DDT delineation used a kaching model to predict depth of contamination. Model generated a depth between 1 and 5 ft. Assumed 5 ft for small area and 2 ft for a larger area as shown on the figure.

3) All other areas contamination was assumed to not exceed 1 ft bls.

4) Planimeter used to calculate volumes.

Area 1: large area surrounding 790 ppm DDT hit
Area 2: Small area surrounding 790 ppm DDT hit
Area 3: Area surrounding 1.5 ppm DDT hit
Area 4: Area surrounding 9 ppm chlordane hit
Area 5: 30' by 40' medium area surrounding 790 ppm DDT hit

Area 1 Scale 1" = 60' Planimeter unit = 0.01 in²

Try #	Start	Finish	Difference	Average	Area (in²)	Area (ft²)
1	5257	5396	139			
2	5502	5641	139	139.7	1.397	5,029
3	5554	5695	141			

$1.397 in^2 \cdot \frac{3600 ft^2}{1 in^2} = 5,029 ft^2$

Area 2 Scale 1" = 60'

Try #	Start	Finish	Difference	Average	Area (in²)	Area (ft²)
1	0694	0699	5			
2	0736	0741	5	5.67	0.0567	204
3	1278	1285	7			

$0.0567 in^2 \cdot \frac{3600 ft^2}{1 in^2} = 204 ft^2$

PROJECT	COMP. BY	JOB NO.
NAVAL Station Mayport SWMU 15 Volumes of Contaminated Media	JH	08533.29
	CHK. BY LDP	DATE 6.5.95

Area 3 Scale 1" = 60'

Try #	Start	Finish	Difference	Avg.	Area (in^2)	Area (ft^2)
①	7283	7347	64			
②	8167	8229	62	62.3	0.623	2,343
③	6274	6335	61			

$0.623\ in^2 \cdot \frac{3600\ ft^2}{1\ in^2} = 2,243\ ft^2$

Area 4 Scale 1" = 60'

Try #	Start	Finish	Difference	Avg.	Area (in^2)	Area (ft^2)
①	5465	5625	160			
②	4759	4917	158	158.7	1.587	5,713
③	5509	5667	158			

$1.587\ in^2 \cdot \frac{3600\ ft^2}{1\ in^2} = 5713\ ft^2$

Area 5 $30' \times 40' = 1,200\ ft^2$

So compute Total Volume of soil affected by 790ppm DDT detection

The difference btwn Area 1 & Area 5 is contaminated up to 1 ft bls so:

$5,029\ ft^2 - 1200\ ft^2 = 3,829\ ft^2$ $\quad 3,829\ ft^2 \cdot 1\ ft = \boxed{3,829\ ft^3}$

Difference Btwn Area 5 & Area 2 is contaminated up to 2ft bls

$1,200\ ft^2 - 204\ ft^2 = 996\ ft^2$ $\quad 996\ ft^2 \cdot 2\ ft = \boxed{1,992\ ft^3}$

Area 2 is contaminated up to 3ft

So: $204\ ft^2 \cdot 3\ ft = \boxed{612\ ft^3}$

Total Volume = $\boxed{6,433\ ft^3}$

PROJECT	COMP. BY	JOB NO.
Naval Station Mayport	TJH	08533.27
SWMU 15 volumes of contaminated media	CHK. BY LDP	DATE 6.5.95

Total volume of soil affected by 1.5 ppm DDT but is 1 ft bls and Area 3

So: $2,243\ ft^2 \cdot 1\ ft = \boxed{2,243\ ft^3}$

Total volume of soil affected by 9 ppm Chlordane detection is 1 ft bls of Area 4

So: $5,713\ ft^2 \cdot 2\ ft = \boxed{5,713\ ft^3}$

Sum of all volumes is:

$6,433\ ft^3 + 2,243\ ft^3 + 5,713\ ft^3 = 14,389\ ft^3$

$\sim \boxed{14,400\ ft^3}$

In cubic yards:

$14,389\ ft^3 \cdot \frac{1\ cy}{27\ cf} = \boxed{533\ yd^3}$

In tons assuming 1.4 g/cm³ density

$14,400\ ft^3 \cdot \frac{1.4\ g}{cm^3} \cdot \left(\frac{2.54\ cm}{1\ in}\right)^3 \left(\frac{12\ in}{1\ ft}\right)^3 \left(\frac{2.2\ lbs}{1\ kg}\right)\left(\frac{1\ kg}{1000\ g}\right) = 1,255,031$

$\sim 1,260,000$

$1,260,000\ lbs \cdot \frac{1\ ton}{2,000\ lbs} = \boxed{630\ \text{tons of soil to be removed}}$

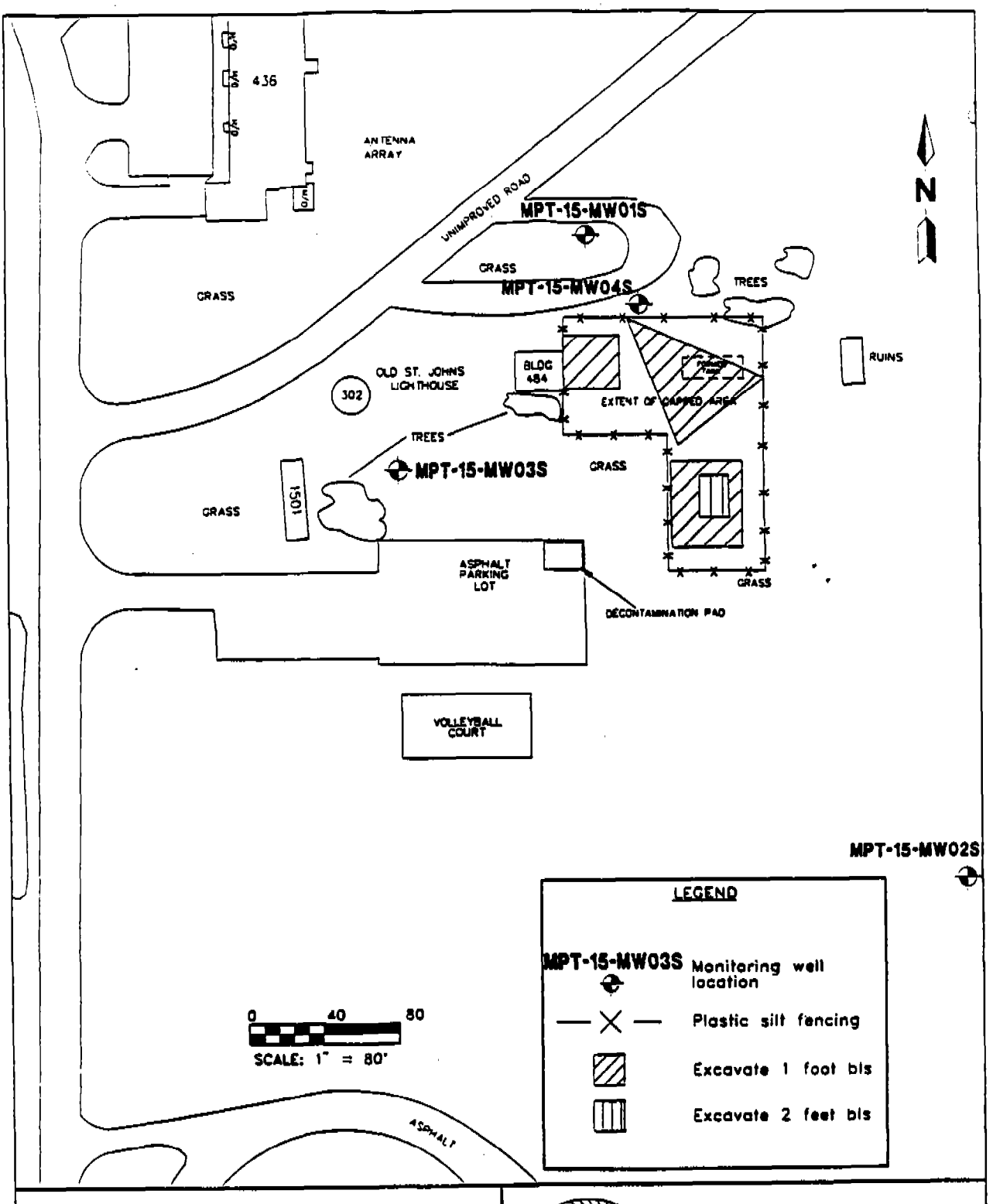

FIGURE 6-9
SITE LAYOUT
ALTERNATIVE 15-1: OFFSITE
TRANSPORT AND INCINERATION

CORRECTIVE MEASURES STUDY
REPORT, GROUP II SWMUs

U.S. NAVAL STATION
MAYPORT, FLORIDA

Modeling DDT Concentrations in Soil

The highest concentration of DDT detected at SWMU 15 was detected in the surface soil sample from MPT-15 SS23. Because no subsurface soil sample was collected at this location, The depth of DDT contamination in the soil is not known. A fate and transport model described by Jury et. al. (1990) was used to estimate the depth of the DDT contamination.

Model Inputs

The following inputs were used for this model:

Soil bulk density - 1.4 g/cm^3 - calculated by averaging bulk density measurements for soil across the facility (ABB-ES, 1995).

Soil volumetric water content - two values were used 0.20 and 0.07 - calculated using the soil bulk density and the percent moisture. Values of 5 and 15 percent moisture were used to calculate the volumetric water content in order to represent the wide range measured in soil across the facility (ABB-ES, 1995). See attached worksheets for calculations.

Soil volumetric air content - two values were used 0.15 and 0.28 - calculated using the soil volumetric water content and the porosity. See attached worksheets for calculations.

Soil porosity - 0.35 (ABB-ES, 1995)

Fraction of organic carbon - 0.003 - calculated by averaging TOC concentrations measured in soil (approximately 2,800 mg/kg) and converting to a dimensionless number. See attached worksheets for calculations.

Air boundary layer thickness - 0.5 cm (Jury et. al., 1990)

Infiltration rate - 0.1 cm/day.- calculated from the annual rainfall assuming 25 percent of rainfall infiltrates (ABB-ES, 1995). See attached worksheets for calculations.

Initial concentration - 2,100 ppm - back calculated from the concentration measured in the surface soil sample from MPT-15-SS23. See attached worksheets for calculations.

Henry's Law constant - 0.000513

Organic carbon partitioning coefficient (K_{oc}) - 230,000 cm^3/g

Half life - 5,500 days

Top of contaminated zone - 0.001 cm below ground surface

Thickness of contaminated zone - 60 cm - Assuming that DDT and it's carrier contaminated the top two feet of soil wh n it was initially spilled.

Model Results

The model was run twice using the different values for volumetric water and air content (see attached printouts). The Jury model only accounts for the fate and transport of DDT alone, it does not account for the facilitated transport of DDT by the carrier during the initial release. To provide for facilitated transport, it was assumed that the initial release of DDT and it's carrier reached a depth of 2 feet (approximately 60 cm). In run, the contamination initially present in the top 60 cm of soil as a result of the release did not reach a depth of 90 cm (approximately 3 feet) after 21 years. It is possible that the DDT was carried deeper than 2 feet below ground surface during the initial release. However, even if the initial release carried DDT deeper than 2 feet, the results of the model indicate that further downward migration after the release is not expected.

The maximum concentration of DDT reported by the model after 21 years was 795 mg/kg. This is consistent with the 790 mg/kg of DDT detected in the sample from MPT-15-SS23. A close correlation between these values is expected because the 790 mg/kg was used to calculate the initial concentration of 2,100 mg/kg used in the model. The initial concentration was calculated using a first order reaction (half-life). Because of DDT's chemical properties, minimal transport is expected and the primary fate for this compound in the model is degradation (half-life decay).

RUN #1
PROJECT TITLE = Mayport SWMU 15 DDT
JOB # = 8533-29
DATE = 6/6/95
NAME = Mark Woodruff

SOIL PROPERTIES

SOIL BULK DENSITY (G/CM3)	=	1.4
SOIL VOLUMETRIC WATER CONTENT (DIM)	=	.2
SOIL VOLUMETRIC AIR CONTENT (DIM)	=	.15
TOTAL SOIL POROSITY (DIM)	=	.35
FRACTION OF ORGANIC CARBON (DIM)	=	.003

TRANSPORT PROPERTIES

AIR BOUNDARY LAYER THICKNESS (CM)	=	.5
INFILTRATION RATE (CM/DAY)	=	.1

CHEMICAL DATA

CHEMICAL NAME	=	DDT
INITIAL CONCENTRATION (PPM)	=	2100
HENRY'S LAW CONSTANT (DIM)	=	.000513
ORGANIC CARBON PART COEF (CM3/G)	=	230000
HALF LIFE (DAYS)	=	5500
DEPTH TO TOP OF CONTAMINANTS (CM)	=	.001
THICKNESS OF CONTAMINANT ZONE (CM)	=	60

CONCENTRATION(PPM) AS A FUNCTION OF TIME AND DEPTH

DEPTH(CM)	TIME(DAYS)				
	1.0	1101.0	2201.0	3301.0	4401.0
0.000	1073.008	29.499	14.292	8.314	5.233
30.000	2099.735	1827.926	1591.302	1385.309	1205.981
60.000	1141.478	1160.094	1091.631	1001.927	907.993
90.000	0.000	0.000	0.000	0.000	0.000

CONCENTRATION(PPM) AS A FUNCTION OF TIME AND DEPTH

DEPTH(CM)	TIME(DAYS)				
	5501.0	6601.0	7701.0	0.0	0.0
0.000	3.444	2.332	1.611	0.000	0.000
30.000	1049.868	913.963	795.651	0.000	0.000
60.000	816.346	729.903	649.947	0.000	0.000
90.000	0.000	0.000	0.000	0.000	0.000

FLUX (MICROGRAMS/CM*CM/DAY) AND LOSS (PERCENT)
AS A FUNCTION OF TIME

TIME(DAYS)	FLUX	LOSS
1.0	-3.517	0.0046
1101.0	-0.099	0.2324
2201.0	-0.050	0.2933
3301.0	-0.030	0.3268
4401.0	-0.019	0.3477
5501.0	-0.013	0.3616
6601.0	-0.009	0.3712
7701.0	-0.007	0.3780

CAUTION: THE USE OF TOO LARGE TIME STEPS MAY CAUSE THE ESTIMATED CUMULATIVE VOLATILIZATION LOSSES TO BE ERRONEOUS. USE THE ESTIMATED TOTAL LOSSES AT INFINITE TIME AS FOLLOWS.

THE TOTAL FRACTION VOLATILIZED IS APPROXIMATELY 0.0105 ASSUMING ZERO WATER EVAPORATION AND LARGE KH (SEE JURY APP. B)

RUN #2
PROJECT TITLE = Mayport SWMU 15 DDT
JOB # = 8533-29
DATE = 6/6/95
NAME = Mark Woodruff

SOIL PROPERTIES

SOIL BULK DENSITY (G/CM3)	=	1.4
SOIL VOLUMETRIC WATER CONTENT (DIM)	=	.07
SOIL VOLUMETRIC AIR CONTENT (DIM)	=	.28
TOTAL SOIL POROSITY (DIM)	=	.35
FRACTION OF ORGANIC CARBON (DIM)	=	.003

TRANSPORT PROPERTIES

AIR BOUNDARY LAYER THICKNESS (CM)	=	.5
INFILTRATION RATE (CM/DAY)	=	.1

CHEMICAL DATA

CHEMICAL NAME	=	DDT
INITIAL CONCENTRATION (PPM)	=	2100
HENRY'S LAW CONSTANT (DIM)	=	.000513
ORGANIC CARBON PART COEF (CM3/G)	=	230000
HALF LIFE (DAYS)	=	5500
DEPTH TO TOP OF CONTAMINANTS (CM)	=	.001
THICKNESS OF CONTAMINANT ZONE (CM)	=	60

CONCENTRATION(PPM) AS A FUNCTION OF TIME AND DEPTH

DEPTH(CM)	TIME(DAYS)				
	1.0	1101.0	2201.0	3301.0	4401.0
0.000	1518.484	90.700	51.286	34.012	24.131
30.000	2099.735	1827.926	1591.302	1385.309	1205.981
60.000	1089.652	1022.400	928.062	833.106	743.560
90.000	0.000	0.000	0.000	0.000	0.000

CONCENTRATION(PPM) AS A FUNCTION OF TIME AND DEPTH

DEPTH(CM)	TIME(DAYS)				
	5501.0	6601.0	7701.0	0.0	0.0
0.000	17.781	13.427	10.314	0.000	0.000
30.000	1049.868	913.963	795.651	0.000	0.000
60.000	661.196	586.422	519.077	0.000	0.000
90.000	0.000	0.000	0.000	0.000	0.000

FLUX (MICROGRAMS/CM*CM/DAY) AND LOSS (PERCENT)
AS A FUNCTION OF TIME

TIME(DAYS)	FLUX	LOSS
1.0	-4.977	0.0054
1101.0	-0.299	0.5722
2201.0	-0.170	0.7672
3301.0	-0.113	0.8882
4401.0	-0.081	0.9719
5501.0	-0.060	1.0328
6601.0	-0.045	1.0785
7701.0	-0.035	1.1135

CAUTION: THE USE OF TOO LARGE TIME STEPS MAY CAUSE THE ESTIMATED CUMULATIVE VOLATILIZATION LOSSES TO BE ERRONEOUS. USE THE ESTIMATED TOTAL LOSSES AT INFINITE TIME AS FOLLOWS.

THE TOTAL FRACTION VOLATILIZED IS APPROXIMATELY 0.0244 ASSUMING ZERO WATER EVAPORATION AND LARGE KH (SEE JURY APP. B)

PROJECT	COMP. BY	JOB NO.
Maypo4	TJH	08533.29
Group II Samples: Volumes of Contaminated Media	CHK. BY LDP	DATE 6.7.95

Calculation for chlordane contamination in subsurface soil

Sample location	Media	Concentration
MPT-15-SSx1	Surface Soil	9.0 ppm
	Subsurface Soil	?
MPT-15-SSx2	Surface Soil	5.6 ppm
	Subsurface Soil	0.18 ppm

Surface Soil 5.6 ppm yields subsurface soil = 0.18 ppm

Set up calculation to estimate subsurface soil concentration at sample location MPT-15-SS

Assume straight line effects

$$\frac{0.18\ ppm}{5.6\ ppm} = \frac{x\ ppm}{9.0\ ppm}$$

$$(9.0\ ppm)(0.18\ ppm) = (5.6\ ppm)(x\ ppm)$$

$$\frac{1.62}{5.6} = x$$

$$x = 0.289 \sim 0.29\ ppm$$

0.29 ppm is below MPS for chlordane in subsurface soil.

APPENDIX B

CALCULATIONS FOR CONFIRMATORY SAMPLING PROGRAM

PROJECT	COMP. BY	JOB NO.
Grid Spacing for Confirmatory Sampling Implementation Plan SWMU 15	SCB	8534-33
	CHK'D BY	DATE 8/16/95

Problem: Determine number of samples to collect during confirmatory sampling

Given: 90% Confidence that a hot spot won't be missed
hot spot is elliptical

Definitions:

β = consumer's risk = 0.1 (based on 90% confidence)

S = shape factor of hot spot = $\frac{\text{length of short axis}}{\text{length of long axis}} = \frac{1}{2}$ (assume)

L = length of semimajor axis of the smallest hot spot important to detect (i.e., a "radius")

G = grid spacing, assuming a square grid is required

Reference: Statistical Methods for Environmental Pollution Monitoring, Gilbert, R.O.; Van Nostrand Reinhold Company, New York, 1987

Step 1: Based on S = 0.5 and β = 0.1 look up an L/G ratio from Figure 10.3 of Gilbert, 1987:

$$\frac{L}{G} = 0.84$$

Step 2: Pick a grid size: Surface Area of Contaminated Soil at SWMU 15 ≈ 15000 sf. Therefore, choose a grid spacing of 25 ft.

Step 3: Solve for L:

$$L = (0.841)(25) = 21 \text{ ft}$$

Conclusion: Using a 25 foot grid spacing would result in a 90% confidence that a hot spot of >21 ft would not be missed through confirmatory sampling.

This analysis indicates that 18 samples never be collected at SWMU 15.

APPENDIX C

RESPONSE TO REGULATORY COMMENTS

ABB

November 10, 1995

Commanding Officer
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
Charleston SC 29418

Attention: Mr. David Driggers (Code 1582)

SUBJECT: **FDEP Technical Review Comments Implementation Plan, Navy Environmental Leadership Program (NELP) Technology Demonstration for Bioaugmentation at SWMU 15 U.S. Naval Station, Mayport, FL Contract No. N62467-87-D-0317 CTO#028**

Dear Mr. Driggers:

The following presents response to comments made in correspondence dated October 19, 1995 by the Florida Department of Environmental Protection (FDEP) concerning the Navy Environmental Leadership Program (NELP) Technology Demonstration for Bioaugmentation at SWMU 15, U.S. Naval Station (NAVSTA), Mayport, Florida dated September 1995.

Comment 1. I Agree with the proposal for ABB-Environmental Services, Inc., (ABB-ES) to collect statistically random and biased samples based on the rationale of prior analytical knowledge and the "hot spot" distribution of contaminants.

Response. Comment acknowledged.

Comment 2. As noted in my review of the FIFCO International (FIFCO) Remedial Action Plan, it is desirable that, to the degree possible, field samples obtained and evaluated by FIFCO should duplicate the ABB confirmatory sample sites since they are based on known and statistically-derived data points.

Response. ABB-ES is responsible only for locating, collecting and analyzing samples described in the Implementation Plan, NELP Technology Demonstration for Bioaugmentation at SWMU 15. ABB-ES is not responsible for locating, collecting or analyzing samples described in FIFCO's Remedial Action Plan (RAP), Bioaugmentation Corrective Action, Naval Station Mayport, Dated August 1995 or any subsequent modification to this plan.

Comment 3. Section 3.1, bullet 4: soil samples: will the mentioned soil samples be obtained by FIFCO personnel or by ABB.

Response. These samples along with the others described in section 3.3 SAMPLING AND ANALYSIS PROGRAM and listed in Table 3-2 of the Implementation Plan will be located, collected and analyzed by ABB-ES.

ABB Environmental Services Inc.

Berkeley Building
2590 Executive Center Circle East
Tallahassee, Florida 32301

Telephone (904) 656-1293
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November 10, 1995
Mr. David Driggers (Code 1852)

Comment 4. As we have discussed on several occasions, the section of Uncertainty will be useful in helping evaluate the work achieved during the demonstration when considering the "hot spot" distribution of contaminants and the relatively unknown remediation media (Bacterra®).

Response. Comment acknowledged.

If you have any questions regarding the response to FDEP's comments, please call me at 904-656-1293.

Very truly yours,

ABB ENVIRONMENTAL SERVICES INC.

Francis K. Lesesne, P.G.
Principal Geologist

Terry J. Hansen, P.G.
Task Order Manager

CC: Ms. Cheryl Mitchel, NAVSTA Mayport